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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b> <small>(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))</small>	Attorney Docket No.	D#00013 (538-44)
	First Inventor or Application Identifier	DeRosa et al.
	Title	FUEL COMPOSITION CONTAINING FRICTION MODIFIER
	Express Mail Label No.	EL393561410US

APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231		
1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) <small>(Submit an original and a duplicate for fee processing)</small>	5. <input type="checkbox"/> Microfiche Computer Program (Appendix)		
2. <input checked="" type="checkbox"/> Specification [Total Pages 26] <small>(preferred arrangement set forth below)</small> <ul style="list-style-type: none"><li>- Descriptive title of the Invention</li><li>- Cross References to Related Applications</li><li>- Statement Regarding Fed sponsored R &amp; D</li><li>- Reference to Microfiche Appendix</li><li>- Background of the Invention</li><li>- Brief Summary of the Invention</li><li>- Brief Description of the Drawings (if filed)</li><li>- Detailed Description</li><li>- Claim(s)</li><li>- Abstract of the Disclosure</li></ul>	6. Nucleotide and/or Amino Acid Sequence Submission <small>(if applicable, all necessary)</small> <ul style="list-style-type: none"><li>a. <input type="checkbox"/> Computer Readable Copy</li><li>b. <input type="checkbox"/> Paper Copy (identical to computer copy)</li><li>c. <input type="checkbox"/> Statement verifying identity of above copies</li></ul>		
3. <input type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets ]	<b>ACCOMPANYING APPLICATION PARTS</b>		
4. Oath or Declaration [Total Pages 6] <ul style="list-style-type: none"><li>a. <input checked="" type="checkbox"/> Newly executed (original or copy)</li><li>b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) <small>(for continuation/divisional with Box 16 completed)</small><ul style="list-style-type: none"><li>i. <input type="checkbox"/> <b>DELETION OF INVENTOR(S)</b> Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).</li></ul></li></ul>	7. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s))		
<b>* NOTE FOR ITEMS 1 &amp; 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).</b>		8. <input type="checkbox"/> 37 C.F.R. § 3.73(b) Statement <input checked="" type="checkbox"/> Power of Attorney <small>(when there is an assignee)</small>	
		9. <input type="checkbox"/> English Translation Document (if applicable)	
		10. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations	
		11. <input type="checkbox"/> Preliminary Amendment	
		12. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) <small>(Should be specifically itemized)</small>	
		13. <input type="checkbox"/> * Small Entity Statement(s) <input type="checkbox"/> Statement filed in prior application, Status still proper and desired <small>(PTO/SB/09-12)</small>	
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		15. <input type="checkbox"/> Other: .....	

**16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:**

<input type="checkbox"/> Continuation	<input type="checkbox"/> Divisional	<input type="checkbox"/> Continuation-in-part (CIP)	of prior application No: _____
Prior application information: Examiner _____			Group / Art Unit: _____

**For CONTINUATION or DIVISIONAL APPS only:** The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

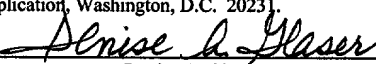
**17. CORRESPONDENCE ADDRESS**

<input type="checkbox"/> Customer Number or Bar Code Label	(Insert Customer No. or Attach bar code label here)	or <input checked="" type="checkbox"/> Correspondence address below
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Name (Print/Type)	Michael E. Carmen	Registration No. (Attorney/Agent)	43,533
Signature		Date	Sept. 20, 2000

CERTIFICATION UNDER 37 C.F.R. § 1.10 I hereby certify that this correspondence and the documents referred to as enclosed are being deposited with the United States Postal Service on date below in an envelope as "Express Mail Post Office to Addressee" Mail Label Number EL393561410US addressed to: Assistant Commissioner for Patents, Box Patent Application, Washington, D.C. 20231.

Dated: September 20, 2000

  
Denise A. Glaser

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Patent fees are subject to annual revision.  
Small Entity payments must be supported by a small entity statement,  
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See 37 C.F.R. §§ 1.27 and 1.28.

## Complete if Known

Application Number	
Filing Date	September 20, 2000
First Named Inventor	DeRosa et al.
Examiner Name	
Group / Art Unit	
Attorney Docket No.	D#00013 (538-44)

TOTAL AMOUNT OF PAYMENT (\$ ) 1,036.00

## METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

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Deposit Account Name DILWORTH & BARRESE, LLP

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Under 37 CFR §§ 1.16 and 1.17

2. ☒ Payment Enclosed:

☒ Check ☐ Money Order ☐ Other

## FEE CALCULATION (continued)

### 3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet.	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 380	216 190	Extension for reply within second month	
117 870	217 435	Extension for reply within third month	
118 1,360	218 680	Extension for reply within fourth month	
128 1,850	228 925	Extension for reply within fifth month	
119 300	219 150	Notice of Appeal	
120 300	220 150	Filing a brief in support of an appeal	
121 260	221 130	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,210	241 605	Petition to revive - unintentional	
142 1,210	242 605	Utility issue fee (or reissue)	
143 430	243 215	Design issue fee	
144 580	244 290	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	\$40
146 690	246 345	Filing a submission after final rejection (37 CFR § 1.129(a))	
149 690	249 345	For each additional invention to be examined (37 CFR § 1.129(b))	
Other fee (specify) _____			
Other fee (specify) _____			
* Reduced by Basic Filing Fee Paid			
SUBTOTAL (3)			(\$ ) 40.00

## FEE CALCULATION

### 1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 690	201 345	Utility filing fee	\$690.00
106 310	206 155	Design filing fee	
107 480	207 240	Plant filing fee	
108 690	208 345	Reissue filing fee	
114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$ ) 690.00

### 2. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
37	-20** = 17	\$18	\$306
Independent Claims 3	-3** = 0	\$78	\$0
Multiple Dependent		\$260	\$0

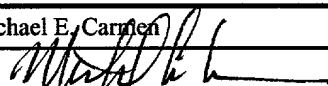
\*\*or number previously paid, if greater; For Reissues, see below

### Large Entity Small Entity

Fee Code (\$)	Fee Code (\$)	Fee Description
103 18	203 9	Claims in excess of 20
102 78	202 39	Independent claims in excess of 3
104 260	204 130	Multiple dependent claim, if not paid
109 78	209 39	** Reissue independent claims over original patent
110 18	210 9	** Reissue claims in excess of 20 and over original patent

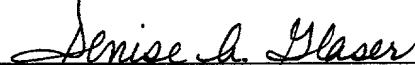
SUBTOTAL (2) (\$ ) 306.00

## SUBMITTED BY

Name (Print/Type)	Michael E. Carmen	Registration No. (Attorney/Agent)	43,533	Telephone	(516) 228-8484
Signature		Date	Sept. 20, 2000		

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Dated: September 20, 2000

  
Denise A. Glaser

FUEL COMPOSITION CONTAINING FRICTION MODIFIERBACKGROUND OF THE INVENTION

This disclosure relates generally to a fuel composition including at least a major amount of an internal combustion engine hydrocarbon fuel, e.g., gasoline, containing at least one alcohol wherein methyl tertiary-butyl ether is substantially absent from the hydrocarbon fuel and a minor amount of a friction modifier and to a method for operating an internal combustion engine employing the fuel composition as the fuel therefor.

The petroleum industry has long recognized a need for greater fuel economy and efficiency in the operation of hydrocarbon fuel powered internal combustion engines, e.g., spark-ignition engines. In many instances, high compression ratios are desired in order to provide for superior engine performance under various driving conditions. The petroleum industry also recognizes that exhaust emissions from spark-ignition powered engines play a significant role in air pollution.

In an effort to lower toxic exhaust emissions, methyl tertiary-butyl ether ('MTBE') has been added to hydrocarbon fuels for use in spark-ignition engines. Hydrocarbon fuels additized with MTBE are referred to as 'oxygenated fuels'. Exhaust emissions from oxygenated fuels generally contain lower levels of, for example, carbon monoxide, hydrocarbon and nitric oxide.

There has been recent concerns over the toxicity of MTBE and the potential health effects therefrom. See, e.g., Office of Research and Development, U.S. Environmental Protection Agency, "Health Risk Perspectives on Fuel Oxygenates", Report No. EPA 600/R-94/217, December, 1994. For example, problems associated with MTBE-containing fuels include environmental concerns relating to the toxicity of the MTBE-containing fuels and acute symptoms such as headaches and nausea from

individuals breathing the fuel's fumes. Thus, it would be desirable to replace MTBE in hydrocarbon fuels thereby eliminating the environmental concerns as well as the potential health effects caused by the use of MTBE-containing fuels.

Ethyl alcohol has been suggested as a replacement for MTBE.

5 Oxygenated fuels derived from ethyl alcohol are significantly less toxic than their MTBE counterpart. Ethyl alcohol-additized fuels, however, demonstratably have reduced fuel economy when used in spark ignition engines.

One approach to achieving enhanced fuel economy while also reducing the wear of engine components is by improving the efficiency of the internal combustion  
10 engine in which the fuel is used. Improvement in the engine's efficiency can be achieved through a number of methods, e.g., (1) improving control over fuel/air ratio; (2) decreasing the crankcase oil viscosity; and, (3) reducing the internal friction of the engine in certain specific areas due to wear. In method (3), for example, inside an engine, about 18 percent of the fuel's heat value, i.e., the amount of heat released in the combustion of  
15 the fuel and therefore able to perform work, is lost by internal friction routes in engine components, e.g., bearings, valve train, pistons, rings, water and oil pumps, etc. Only about 25 percent of the fuel's heat value is converted to useful work at the crankshaft. Friction occurring at the piston rings and parts of the valve train account for over 50 percent of the heat value loss. A lubricity improving fuel additive, e.g., a friction  
20 modifier, capable of reducing friction at these engine components by 1/3 preserves an additional 3% of the fuel's heat value for useful work at the crankshaft. Therefore, there has been a continual search for friction modifiers which improve the delivery of friction modifier to strategic areas of the engine thereby improving the fuel economy of engines.

For example, U.S. Patent Nos. 2,252,889, 4,185,594, 4,208,190, 4,204,481  
25 and 4,428,182 disclose anti-wear additives for fuels adapted for use in diesel engines consisting of fatty acid esters, unsaturated dimerized fatty acids, primary aliphatic amines, fatty acid amides of diethanolamine and long-chain aliphatic monocarboxylic acids.

U.S. Patent No. 4,427,562 discloses a friction reducing additive for lubricants and fuels formed by the reaction of primary alkoxyalkylamines with carboxylic acids or alternatively by the ammonolysis of the appropriate formate ester.

U.S. Patent No. 4,729,769 discloses a detergent additive for gasoline,  
5 which contains the reaction product of a C<sub>6</sub>-C<sub>20</sub> fatty acid ester such as coconut oil and a mono- or di-hydroxy hydrocarbyl amine such as diethanolamine or dimethylaminopropylamine.

### SUMMARY OF THE INVENTION

10 In accordance with the present invention, a fuel composition is provided which comprises:

(a) a major amount of an internal combustion engine hydrocarbon fuel containing at least one alcohol, it being provided that methyl tertiary-butyl ether is substantially absent from the fuel; and,

15 (b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and at least one alkanolamine.

Further in accordance with the present invention, a method of operating an internal combustion engine is provided which comprises operating the engine employing as a fuel therefor a fuel composition which comprises:

20 (a) a major amount of an internal combustion engine hydrocarbon fuel containing at least one alcohol, it being provided that methyl tertiary-butyl ether is substantially absent from the fuel; and,

(b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and at least one alkanolamine.

25 The term "hydrocarbon fuel" as utilized herein shall be understood as referring to those hydrocarbon fuels such as, for example, gasoline or diesel.

The term "gasoline" as utilized herein shall be understood as referring to a fuel for spark-ignition internal combustion engines consisting essentially of volatile flammable liquid hydrocarbons derived from crude petroleum by processes such as distillation reforming, polymerization, catalytic cracking, and alkylation.

5           The term "diesel" as utilized herein shall be understood as referring to that fraction of crude oil that distills after kerosene and is useful for internal combustion in compression-ignition engines.

10           The term "natural oil" utilized herein refers to those naturally occurring oils that are derived from animal or plant sources. Such oils are mixed C<sub>6</sub>-C<sub>22</sub> fatty acid esters, i.e., glycerol fatty acid esters, and include specifically coconut oil, babassu oil, palm kernel oil, palm oil, olive oil, castor oil, rape oil, beef tallow oil, whale oil, sunflower, cottonseed oil, linseed oil, tung oil, tallow oil, lard oil, peanut oil, soya oil, etc. It will be understood that such oils will predominately comprise triglycerides with small amounts, e.g. up to about 10 weight percent, of mono- and diglycerides.

15           The term "synthetic oil" utilized herein refers to products produced by reacting carboxylic acids with glycerol, e.g., glycerol triacetate, and the like. It will be understood that such synthetic oils can contain between about 0.1 wt. % to about 20 wt. % mono- and di-glycerides, and mixtures thereof.

20           The hydrocarbon fuels containing at least one alcohol and wherein MTBE is substantially absent therefrom are less toxic than those fuels containing MTBE. Additionally, by utilizing a friction modifier in the fuel composition of this invention, greater fuel economy and efficiency in the operation of a hydrocarbon fuel powered internal combustion engine employing the foregoing fuel composition can be achieved.

## 25           DESCRIPTION OF THE PREFERRED EMBODIMENTS

By employing the aforesaid reaction product in a friction modifying amount in the fuel composition of this invention, greater fuel economy and efficiency in the operation of internal combustion engines can be achieved than a fuel containing only

an alcohol with MTBE being substantially absent therefrom. Additionally, the fuel composition of this invention exhibits substantially less toxicity than those fuels containing MTBE. In general, the fuel composition of this invention will include at least (a) a major amount of an internal combustion engine hydrocarbon fuel containing at least one alcohol, it being provided that MTBE is substantially absent from the hydrocarbon fuel and (b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and at least one alkanolamine.

Suitable base fuels for use in formulating the fuel composition of this invention include any hydrocarbon fuel such as, for example, gasoline, diesel, kerosene, jet fuels, etc. When the fuel is gasoline, it can be derived from straight-chain naphtha, polymer gasoline, natural gasoline, catalytically cracked or thermally cracked hydrocarbons, catalytically reformed stocks, and the like. It will be understood by one skilled in the art that gasoline fuels typically boil in the range of from about 80°F to about 450°F and can consist of straight chain or branched chain paraffins, cycloparaffins, olefins, aromatic hydrocarbons and any mixture of these.

When the fuel is diesel, such fuels generally boil above about 212°F. The diesel fuel can comprise atmospheric distillate or vacuum distillate, or a blend in any proportion of straight run and thermally and/or catalytically cracked distillates. Preferred diesel fuels have a cetane number of at least 40, preferably above 45 and more preferably above 50. The diesel fuel can have such cetane numbers prior to the addition of any cetane improver with the cetane number of the fuel being increased by the addition of the cetane improver.

The base fuel will also contain at least one alcohol in order to reduce exhaust emissions from the engine. Suitable alcohols for use herein include methanol, ethanol, propanol, isopropanol, butanol, t-butanol, pentanol, hexanol, heptanol, octanol, nonanol, decanol, undecanol, dodecanol, tridecanol, tetraanol, pentadecanol, phenol and the like and mixtures thereof. A preferred alcohol for use herein is ethanol. Generally, the alcohol is present in the base fuel in an amount below about 25 percent by volume,

preferably in an amount ranging from about 0.5 to about 20 percent by volume and more preferably in an amount that provides an oxygen content in the overall fuel in the range of about 1 to about 15 percent by volume.

Generally, a friction modifying amount of a reaction product of at least one natural or synthetic oil with at least one alkanolamine is advantageously employed to form the fuel composition of this invention.

Natural oils such as mixed  $C_6$ - $C_{22}$  fatty acid esters, i.e., glycerol fatty acid esters or triglycerides derived from natural sources, for use herein include, but are not limited to, beef tallow oil, lard oil, palm oil, castor oil, cottonseed oil, corn oil, peanut oil, soybean oil, sunflower oil, olive oil, whale oil, menhaden oil, sardine oil, coconut oil, palm kernel oil, babassu oil, rape oil, soya oil and the like with coconut oil being the preferred natural oil.

The natural oil(s) which can be employed in the fuel additive composition of this invention will typically contain  $C_6$ - $C_{22}$  fatty acid esters, i.e., several fatty acid moieties, the number and type varying with the source of the oil. Fatty acids are a class of compounds containing a long hydrocarbon chain and a terminal carboxylate group and are characterized as unsaturated or saturated depending upon whether a double bond is present in the hydrocarbon chain. Therefore, an unsaturated fatty acid has at least one double bond in its hydrocarbon chain whereas a saturated fatty acid has no double bonds in its fatty acid chain. Preferably, the acid is saturated. Examples of unsaturated fatty acids include, myristoleic acid, palmitoleic acid, oleic acid, linolenic acid, and the like. Examples of saturated fatty acids include caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, arachidic acid, behenic acid, lignoceric acid, and the like.

The acid moiety may be supplied in a fully esterfied compound or one which is less than fully esterfied, e.g., glyceryl tri-stearate, or glyceryl di-laurate and glyceryl mono-oleate, respectively. Esters of polyols including diols and polyalkylene glycols can be employed such as esters of mannitol, sorbitol, pentaerytherol, polyoxyethylene polyol and the like.



Synthetic oils for use herein include alkoxylated alkylphenols, alkoxylated alcohols, polyalkeneoxide based alcohols and diols, esters thereof employing carboxylic acids, ethers of the foregoing compounds, esters of aliphatic acids, e.g., polybasic acids, and esters of aliphatic alcohols, e.g., polyhydric alcohols, and the like.

5           The alkanolamine which is reacted with the natural or synthetic oil(s) to form a reaction product can be, for example, a primary or secondary amine which possesses at least one hydroxy group. The expression "alkanolamine" is used in its broadest sense to include compounds containing at least one primary or secondary amine and at least one hydroxy group such as, for example, monoalkanolamines,  
10       dialkanolamines, and so forth. It is believed that almost any alkanolamine can be used, although preferred alkanolamines are lower alkanolamines generally having from about two to about six carbon atoms. The alkanolamine can possess an O or N functionality in addition to the one amino group (that group being a primary or secondary amino group) and the at least one hydroxy group. The alkanolamine preferably possesses the general  
15       formula  $\text{HN}(\text{R}'\text{OH})_{2-x} \text{H}_x$  wherein  $\text{R}'$  is a lower hydrocarbyl having from about two to about six carbon atoms and  $x$  is 0 or 1. Suitable alkanolamines for use herein include monoethanolamine, diethanolamine, propanolamine, isopropanolamine, dipropanolamine, di-isopropanolamine, butanolamines, aminoethylaminoethanols, e.g., 2-(2-aminoethylamino)ethanol, and the like. It is also contemplated that mixtures of two or  
20       more alkanolamines can be employed. Diethanolamine is highly preferred for use in accordance with the practice of the present invention.

          In general, the reaction can be conducted by heating the mixture of natural or synthetic oil(s) and alkanolamine in the desired ratio to produce the desired reaction product. The reaction can typically be conducted by maintaining the reactants at a  
25       temperature of from about 100°C - 200°C and preferably from about 120°C - 150°C for a time period ranging from about 1-10 hours and preferably from about 2-4 hours. The weight ratio of natural or synthetic oil(s) to alkanolamine will ordinarily range from about 0.2 to about 3 and preferably from about 0.7 to about 2.

If desired, the reaction can be carried out in solvent, preferably one which is compatible with the ultimate composition in which the product is to be used. Useful solvents include, but are not limited to, Aromatic-100, Aromatic-150, Shellsolv AB, Avjet, toluene, xylene, and the like and mixtures thereof.

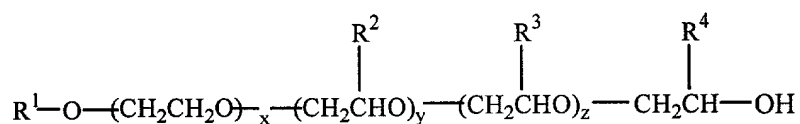
5 It will be readily understood and appreciated by those skilled in the art that the foregoing reaction product constitutes a complex mixture of compounds including fatty acid amides, fatty acid esters, fatty acid ester-amides, unreacted starting reactants, free fatty acids, glycerol, and partial fatty acid esters of glycerol (i.e., mono- and di-glycerides). Fatty acid amides are formed when the amine group of the alkanolamine  
10 reacts with the carboxyl group of a fatty acid. Fatty acid esters are formed when one or more hydroxyl groups of the alkanolamine reacts with the carboxyl group of a fatty acid. Fatty acid ester-amides are formed when both the amine and hydroxyl group of the alkanol amine reacts with the carboxyl groups of fatty acids. Typically, the reaction product will contain from about 5 to about 65 mole % of the fatty acid amide as well as  
15 about 5 to about 65 mole % of the fatty acid ester-amide, about 3 to about 30 mole % of the fatty acid ester, about 0.1 to about 50 mole % of the partial fatty acid ester, about 0.1 to about 30 mole % of the by-product typified by glycerol, about 0.1 to about 30 mole % of free fatty acids, about 0.1 to about 30 mole % of the charge alkanolamine, about 0.1 to about 30 mole % of the charge glycerides, etc. The reaction product mixture need not be  
20 separated to isolate one or more specific components. Indeed, the reaction product mixture can be preferably employed as is in the fuel composition of this invention.

Generally, the friction modifying amount of the foregoing reaction product employed in the fuel composition of this invention will range from about 0.1 to about 1000 pounds per thousand barrels (PTB), preferably from about 10 to about 500 PTB and  
25 more preferably from about 25 to about 150 PTB.

If desired, the base fuel and reaction product of natural or synthetic oil(s) and alkanolamine can be used in combination with a carrier. Such carriers can be of various types such as liquid carriers (also referred to as a solvent, diluent or induction aid) or solids, e.g., waxes, with liquid carriers being preferred. Representatives of the liquid

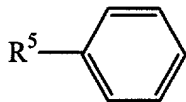
carriers that can be used herein are those disclosed in U.S. Patent Nos. 5,551,957, 5,634,951 and 5,679,116, the contents of which are incorporated by reference herein. Examples of suitable liquid carriers include such materials as liquid poly- $\alpha$ -olefin oligomers such as, for example, hydrotreated and unhydrotreated poly- $\alpha$ -olefin oligomers, i.e., hydrogenated or unhydrogenated products, primarily trimers, tetramers and pentamers of  $\alpha$ -olefin monomers which monomers contain from about 6 to about 12 carbon atoms; liquid polyalkene hydrocarbons, e.g., polypropene, polybutene, polyisobutene, or the like; liquid hydrotreated polyalkene hydrocarbons, e.g., hydrotreated polypropene, hydrotreated polybutene, hydrotreated polyisobutene, or the like; mineral oils; liquid polyoxyalkylene compounds; liquid alcohols or polyols; liquid esters, and similar liquid carriers or solvents. It is also contemplated that mixtures of two or more such carriers or solvents can be employed herein.

Preferred liquid carriers for use herein are polyethers such as substituted polyethers, cyclic polyethers (i.e., crown ethers), aromatic polyethers, polyether alcohols, and the like with polyether alcohols being most preferred. In general, the polyether alcohol(s) will possess the general formula



wherein x is an integer from 0 to about 5, y is an integer from 1 to about 49 preferably from about 5 to about 40 and more preferably from about 5 to about 10, z is an integer from 1 to about 49, preferably from about 5 to about 40 and more preferably from about 5 to about 10 and the sum of x + y + z is equal to 3 to about 50; R<sup>1</sup> is an alkyl, an alicyclic or an alkylalicyclic radical having from about 4 to about 30 carbon atoms or an alkylaryl where the alkyl group is from about 4 to about 30 carbon atoms, including, by way of illustration, unsubstituted straight or branched aliphatic, cycloaliphatic and aromatic

groups and cycloaliphatic and aromatic groups substituted with one or more straight or branched aliphatic, cycloaliphatic and/or aromatic groups. Thus, for example, R<sup>1</sup> can be represented by the general formula



wherein R<sup>5</sup> is a hydrocarbonyl group of from about 4 to about 30 carbon atoms including, by way of example, a monovalent aliphatic radical having from about 6 to about 24 carbon atoms, preferably from about 8 to about 20 carbon atoms and more preferably from about 9 to about 18 carbon atoms. R<sup>2</sup> and R<sup>3</sup> each is different and is an alkyl group of from 1 to 4 carbon atoms and each oxyalkylene radical can be any combination of repeating oxyalkylene units to form random or block copolymers with the random copolymers being preferred; and R<sup>4</sup> is the same as R<sup>2</sup> or R<sup>3</sup>. The preferred polyether alcohol for use herein as the liquid carrier is a mixture of 2-(4-n-nonyl (poly(propylene oxide-co-butylene oxide) phenylether)-1-n-propyl alcohol and 2-(4-n-nonyl(poly(propylene oxide-co-butylene oxide) phenylether)-1-n-butyl alcohol.

It is also advantageous to employ at least one fuel detergent in the fuel composition of this invention. The fuel detergent for use herein can be any commercially available fuel detergent known to one skilled in the art employed to reduce the incidence of deposit formation in the combustion chamber and intake system of an engine. Suitable fuel detergents include any polyether amine and/or one or more of the type based on a polyolefin, e.g., polyethylene, polypropylene, polybutylene, including isomers thereof, and copolymers of at least two of the foregoing; and polyolefin-based detergents, e.g., imides such as succinimide, amines and the like where the latter may be made by chlorinating selected olefins, and reacting the thus-chlorinated olefins with polyamines, e.g., ethylenediamine, tetraethylenepentaamine, etc. A suitable selected olefin is polyisobutene having a molecular weight in the range of from 450 to 1500, and more preferably 900 to 1400. Another suitable detergent may be based on a polyisobutene, preferably of molecular weight in the range of from 450 to 1500, more preferably 900 to

1400, which has been reacted with maleic acid and the resulting acid-functionalised polyolefin thereafter reacted with a polyamine such as tetraethylenepentamine. Processes not involving chlorine are also known. For example, the OXO process used by BASF in preparing a polyolefin-amine which are commercially available as Puradd FD-100 and the like.

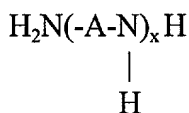
Another suitable detergent for use herein is a Mannich base detergent. The Mannich base detergent can be any commercially available Mannich base known to one skilled in the art. Representative of the Mannich bases are those disclosed in U.S. Patent Nos. 3,368,972; 3,413,347; 3,539,633; 3,752,277; 4,231,759; and, 5,634,951 the contents of which are incorporated by reference herein.

In general, Mannich bases can be obtained from, for example, the condensation reaction product of an alkylphenol, aldehyde and amine or polyamine. Methods for preparing these Mannich base compounds are known in the art and do not constitute a part of the present invention. The alkylphenol can be mono or dialkyl substituted with the alkyl group being substituted in the para position being preferred. The alkyl group can contain from about 50 to about 20,000 carbon atoms, and preferably from about 200 to about 300 carbon atoms. Suitable alkylphenols include polypropylphenol, polybutylphenol, polyisobutylphenol, polypentylphenol, polybutyl-co-polypropylphenols and the like. Other similar long-chain alkylphenols may be used, but are less preferred.

The aldehyde employed in the Mannich base can be free aldehyde, aqueous solution of aldehyde or a polymerized form of an aldehyde which can provide monomeric aldehyde under the reaction conditions. Representative aldehydes for use in the preparation of the Mannich base products include aliphatic aldehydes such as formaldehyde, acetaldehyde, propionaldehyde, butyraldehyde, valeraldehyde, caproaldehyde, heptaldehyde, stearaldehyde and the like; aromatic aldehydes such as benzaldehyde, salicylaldehyde and the like, heterocyclic aldehydes such as furfural, thiophene aldehyde and the like. Other

aldehydes include formaldehyde-producing reagents such as paraformaldehyde, aqueous formaldehyde solutions e.g., formalin and the like, with formaldehyde and formalin being preferred.

The amine can be any one of a wide range of amines having a reactive nitrogen group, and generally contains less than about 100 carbon atoms. Suitable amines include polyamines of the general formula:



wherein A is a divalent alkylene radical of 2 to about 6 carbon atoms and x is an integer of 1 to 10 and preferably of 2 to 6. Useful polyamines include poly-ethyleneamines, propylene-polyamines, ethylenediamine, diethylenetriamine, triethylenetetramine, tetraethylenepentamine, pentaethylene hexamine, hexaethyleneheptamine, propylenediamine, dipropylenetriamine, tripropylenetetramine, tetrapropylenepentamine, pentapropylenehexamine, hexapropyleneheptamine and the like with ethylenepolyamines such as tetraethylenepentamine being preferred. The polyamines can be prepared by methods well-known in the art.

When a polyamine which has more than two amino groups is a reactant, and more than two moles each of alkylphenol and formaldehyde per mole of polyamine are used, the internal amino groups may also have alkyl-and hydroxy-substituted benzyl substituents. Depending upon the particular polyamine used, the particular ratio of alkylphenol and formaldehyde to polyamine employed, the reaction produced may have none, some, or all of the internal amine groups of the polyamine substituted with an alkyl-and hydroxy-substituted benzyl group.

Any amine used may have additional substitutions so long as it does not destroy the fuel solubility of the final Mannich compound, and does not interfere with the Mannich condensation. For example, hydroxyl substituted amines can be employed herein.

The fuel composition of this invention can be prepared by mixing the base fuel (a) containing at least one alcohol therein with the reaction product (b) and, optionally, a carrier and/or fuel detergent, either sequentially or in any suitable order. For example, the base fuel can be combined with the reaction product and then this mixture is combined with the carrier and/or fuel detergent or a mixture of reaction product and carrier and/or fuel detergent can be combined with the base fuel. This mixing can take place before the addition of the reaction product to the fuel or during the mixing of the fuel containing the reaction product of this invention. The order of addition and/or combinations of the various components of this invention is therefore not critical and all such orders of addition and/or combination of the components are envisioned as being within the scope of the invention herein.

In the fuel composition of this invention, other fuel additives can be employed to enhance the performance of the fuel, including, for example, antioxidants, corrosion inhibitors, dehazers, demulsifiers, metal deactivators, antifoaming agents, combustion improvers such as cetane improvers, co-solvents, package compatibilisers, metallic-based additives such as metallic combustion improvers, anti-knock agents, anti-icing additives and mixtures thereof.

A fuel composition containing the friction modifying amount of the aforesaid reaction product of the invention is suitable for the operation of an internal combustion engine. When the base fuel is gasoline, the fuel composition will be suitable for use in, e.g., spark-ignition engines typically operated on such fuels. When the base fuel is diesel, the fuel composition will be suitable for use in, e.g., compression-ignition engines typically operated on such fuels. It is to be understood that the fuel compositions of this invention can be used to operate a variety of engines and in any other application requiring a fuel, e.g., jet engines, furnaces, etc.

The following examples serve to illustrate the method of making the present fuel composition.

## EXPERIMENTAL SECTION

### I. Preparation of Friction Modifier

#### Example 1

5           1.3 Kg coconut oil (approximate molecular weight 657 AMU) was heated to about 60°C and 0.38 Kg diethanolamine was added with stirring. The mixture was then heated under nitrogen to 120°C and held at 120°C for 4 hours and polish-filtered at 100°-120°C. The product was quantitatively isolated as a yellow semi-solid containing a nitrogen content of 2.9% and base number TBN target of 9.

### II. Preparation of Fuel Blends

#### Gasoline Blend 1

15           Gasoline fuel containing 0 percent by volume MTBE and 10 percent by volume ethanol was additized with 52 PTB of the friction modifier of Example 1.

#### Gasoline Blend 2

            Gasoline fuel containing 0 percent by volume MTBE and 10 percent by volume ethanol was additized with 100 PTB of the friction modifier of Example 1.

#### Gasoline Blend 3

20           Gasoline fuel containing 0 percent by volume MTBE and 13 percent by volume ethanol was additized with 52 PTB of the friction modifier of Example 1.

#### Comparative Gasoline Blend A

25           A gasoline fuel containing 0 percent by volume MTBE and ethyl alcohol was additized with 52 PTB of the friction modifier of Example 1.



### Comparative Gasoline Blend B

A gasoline fuel containing 0 percent by volume MTBE and 10 percent by volume ethanol.

5

### Comparative Gasoline Blend C

A gasoline fuel containing 0 percent by volume MTBE and 13 percent by volume ethanol.

### III. Test Results

10

Lubricity testing of the Gasoline Blends 1-3 and Comparative Gasoline Blends A and B were performed at 25°C using the High Frequency Reciprocating Rig (HFRR) method described in ASTM method D 6079-97. Wear Scar Diameter (WSD) of Friction Modifiers is calculated using Equation (1):

Eq. (1) 
$$\text{WSD} = (M + N)/2$$

15

WSD = wear scar diameter, mm

M = Major Axis, mm

N = Minor Axis, mm

20

The HFRR test results are summarized below in Table 1.

**Table 1**

	<u>Sample</u>	<u>Ethanol Amount (vol%)</u>	<u>Co-Additive</u>	<u>Co-additive Amount (PTB)</u>	<u>HFRR (mm)</u>
5	Comp. Blend A	--	Friction Modifier	52	455
	Comp. Blend B	10	None	--	712
	Blend 1	10	Friction Modifier	52	642
	Blend 2	10	Friction Modifier	100	512
10	Comp. Blend C	13	None	--	846
	Blend 3	13	Friction Modifier	52	468

As these data illustrate, by employing a friction modifier together with gasoline containing 10 percent by volume ethanol in Blend 1 (which is within the scope of this invention) as compared to gasoline containing 10 percent by volume ethanol with no friction modifier in Comparative Blend B (which is outside the scope of this invention) significantly greater fuel economy was achieved, i.e., an HFRR of 642 for Blend 1 as compared to 712 for Comparative Blend B. Additionally, by employing the friction modifier together with gasoline containing 13 percent by volume ethanol in Blend 3 (which is within the scope of this invention) as compared to gasoline containing 13 percent by volume ethanol with no friction modifier in Comparative Blend C (which is outside the scope of this invention) significantly greater fuel economy was still achieved, i.e., an HFRR of 468 for Blend 3 compared to 846 for Comparative Blend C. It is both unexpected but readily apparent that incorporating the reaction product mixture of coconut oil and diethanolamine into a hydrocarbon fuel containing at least one alcohol with MTBE being substantially absent therefrom significantly improves the fuel economy and efficiency of the internal combustion engine.

WHAT IS CLAIMED IS:

1. A fuel composition comprising:

(a) a major amount of an internal combustion engine hydrocarbon fuel containing at least one alcohol, it being provided that methyl tertiary-butyl ether is

5 substantially absent from the fuel; and,

(b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and at least one alkanolamine.

2. The fuel composition of Claim 1 wherein the hydrocarbon fuel is  
10 selected from the group consisting of gasoline, diesel, kerosene and jet fuels.

3. The fuel composition of Claim 1 wherein the alcohol is selected from the group consisting of methanol, ethanol, propanol, isopropanol, butanol, t-butanol, pentanol, hexanol, heptanol, octanol, nonanol, decanol, undecanol, dodecanol, tridecanol,  
15 tetradecanol, pentadecanol, phenol and mixtures thereof.

4. The fuel composition of Claim 1 wherein the alcohol is present in the hydrocarbon fuel in an amount of less than about 25 percent by volume.

20 5. The fuel composition of Claim 1 wherein the natural oil is a C<sub>6</sub>-C<sub>22</sub> fatty acid ester.

6. The fuel composition of Claim 1 wherein the natural oil is selected from the group consisting of beef tallow oil, lard oil, palm oil, castor oil, cottonseed oil, corn oil, peanut oil, soybean oil, sunflower oil, olive oil, whale oil, menhaden oil, sardine oil, coconut oil, palm kernel oil, babassu oil, rape oil and soya oil.

5

7. The fuel composition of Claim 1 wherein the alkanolamine is selected from the group consisting of monoethanolamine, diethanolamine, propanolamine, isopropanolamine, dipropanolamine, di-isopropanolamine, butanolamines, aminoethylaminoethanol and mixtures thereof.

10

8. The fuel composition of Claim 1 wherein the weight ratio of natural or synthetic oil to alkanolamine is from about 0.2 to about 3.

15

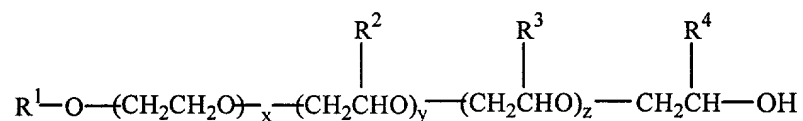
9. The fuel composition of Claim 1 wherein the friction modifying amount of the reaction product of component (b) present in the fuel composition is from about 0.1 to about 1000 PTB.

10. The fuel composition of Claim 1 further comprising a carrier.

20

11. The fuel composition of Claim 10 wherein the carrier is a liquid carrier selected from the group consisting of substituted polyethers, cyclic polyethers aromatic polyethers and polyether alcohols.

12. The fuel composition of Claim 11 wherein the polyether alcohol possesses the general formula



wherein x is an integer from 0 to about 5, y is an integer from 1 to about 49 preferably from about 5 to about 40 and more preferably from about 5 to about 10, z is an integer from 1 to about 49, preferably from about 5 to about 40 and more preferably from about 5 to about 10 and the sum of x + y + z is equal to 3 to about 50; R<sup>1</sup> is an alkyl, an alicyclic or an alkylalicyclic radical having from about 4 to about 30 carbon atoms or an alkylaryl where the alkyl group is from about 4 to about 30 carbon atoms; R<sup>2</sup> and R<sup>3</sup> each is different and is an alkyl group of from 1 to 4 carbon atoms and each oxyalkylene radical can be any combination of repeating oxyalkylene units to form random or block copolymers; and R<sup>4</sup> is the same as R<sup>2</sup> and R<sup>3</sup>.

13. The fuel composition of Claim 12 wherein the polyether alcohol is a mixture of 2-(4-n-nonyl (poly(propylene oxide-co-butylene oxide) phenylether)-1-n-propyl alcohol and 2-(4-n-nonyl(poly(propylene oxide-co-butylene oxide) phenylether)-1-n-butyl alcohol.

14. The fuel composition of Claim 10 wherein the amount of the carrier present in the fuel additive composition is from about 10 to about 1000 PTB.

15. The fuel composition of Claim 1 further comprising at least one fuel detergent.

16. The fuel composition of Claim 15 wherein the fuel detergent is selected from the group consisting of Mannich base detergents, polyetheramines, polyolefin-amines, polyolefin-polyamines, polyolefin-phenol-polyamines, polyolefin succinimides and mixtures thereof.

17. A method of operating an internal combustion engine which comprises operating the engine employing as a fuel therefor a fuel composition which comprises:

(a) a major amount of an internal combustion engine hydrocarbon fuel containing at least one alcohol, it being provided that methyl tertiary-butyl ether is substantially absent from the fuel; and,

(b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and an alkanolamine.

18. The method of Claim 17 wherein the hydrocarbon fuel is selected from the group consisting of gasoline, diesel, kerosene and jet fuels.

19. The method of Claim 17 wherein the alcohol is selected from the group consisting of methanol, ethanol, propanol, isopropanol, butanol, t-butanol, pentanol, hexanol, heptanol, octanol, nonanol, decanol, undecanol, dodecanol, tridecanol, tetradecanol, pentadecanol, phenol and mixtures thereof.

5

20. The method of Claim 17 wherein the alcohol is added to the hydrocarbon fuel in an amount of less than about 25 percent by volume.

21. The method of Claim 17 wherein the natural oil is a C<sub>6</sub>-C<sub>22</sub> fatty acid ester.

10

22. The method of Claim 17 wherein the natural oil is selected from the group consisting of beef tallow oil, lard oil, palm oil, castor oil, cottonseed oil, corn oil, peanut oil, soybean oil, sunflower oil, olive oil, whale oil, menhaden oil, sardine oil, coconut oil, palm kernel oil, babassu oil, rape oil and soya oil.

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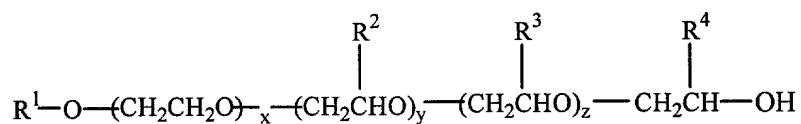
23. The method of Claim 17 wherein the alkanolamine is selected from the group consisting of monoethanolamine, diethanolamine, propanolamine, isopropanolamine, dipropanolamine, di-isopropanolamine, butanolamines, aminoethylaminoethanol and mixtures thereof.

20

24. The method of Claim 17 wherein the weight ratio of natural or synthetic oil to alkanolamine is from about 0.2 to about 3.

25. The method of Claim 17 wherein the fuel composition further comprises a carrier.

26. The method of Claim 25 wherein the carrier is a polyether alcohol of the general formula



wherein x is an integer from 0 to about 5, y is an integer from 1 to about 49 preferably from about 5 to about 40 and more preferably from about 5 to about 10, z is an integer from 1 to about 49, preferably from about 5 to about 40 and more preferably from about 5 to about 10 and the sum of x + y + z is equal to 3 to about 50; R<sup>1</sup> is an alkyl, an alicyclic or an alkylalicyclic radical having from about 4 to about 30 carbon atoms or an alkylaryl where the alkyl group is from about 4 to about 30 carbon atoms; R<sup>2</sup> and R<sup>3</sup> each is different and is an alkyl group of from 1 to 4 carbon atoms and each oxyalkylene radical can be any combination of repeating oxyalkylene units to form random or block copolymers; and R<sup>4</sup> is the same as R<sup>2</sup> and R<sup>3</sup>.



27. The method of Claim 25 wherein the amount of the carrier present in the fuel composition is from about 10 to about 1000 PTB.

28. The method of Claim 17 wherein the fuel composition further  
5 comprises at least one fuel detergent.

29. The method of Claim 28 wherein the fuel detergent is selected from the group consisting of Mannich base detergents, polyetheramines, polyolefin-amines, polyolefin-polyamines, polyolefin-phenol-polyamines, polyolefin succinimides and  
10 mixtures thereof.

30. A method of reducing friction in an internal combustion engine comprising the step of adding to the engine a fuel composition comprising:

(a) a major amount of an internal combustion engine hydrocarbon fuel  
15 containing at least one alcohol, it being provided that methyl tertiary-butyl ether is substantially absent from the fuel; and,

(b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and at least one alkanolamine.

31. The method of Claim 30 wherein the hydrocarbon fuel is selected  
20 from the group consisting of gasoline, diesel, kerosene and jet fuels.

32. The method of Claim 30 wherein the alcohol is selected from the group consisting of methanol, ethanol, propanol, isopropanol, butanol, t-butanol, pentanol, hexanol, heptanol, octanol, nonanol, decanol, undecanol, dodecanol, tridecanol, tetradecanol, pentadecanol, phenol and mixtures thereof.

5

33. The method of Claim 30 wherein the alcohol is added to the hydrocarbon fuel in an amount of less than about 25 percent by volume.

34. The method of Claim 30 wherein the natural oil is a C<sub>6</sub>-C<sub>22</sub> fatty acid ester.

10

35. The method of Claim 30 wherein the natural oil is selected from the group consisting of beef tallow oil, lard oil, palm oil, castor oil, cottonseed oil, corn oil, peanut oil, soybean oil, sunflower oil, olive oil, whale oil, menhaden oil, sardine oil, coconut oil, palm kernel oil, babassu oil, rape oil and soya oil.

15

36. The method of Claim 30 wherein the alkanolamine is selected from the group consisting of monoethanolamine, diethanolamine, propanolamine, isopropanolamine, dipropanolamine, di-isopropanolamine, butanolamines, aminoethylaminoethanol and mixtures thereof.

20

37. The method of Claim 30 wherein the weight ratio of natural or synthetic oil to alkanolamine is from about 0.2 to about 3.

## ABSTRACT OF THE INVENTION

A fuel composition comprising (a) a major amount of an internal combustion engine hydrocarbon fuel containing at least one alcohol, it being provided that MTBE is substantially absent from the fuel and (b) a friction modifying amount of a reaction product of at least one natural or synthetic oil and at least one alkanolamine is provided. Also provided is a method for operating an engine employing the fuel composition therefor.

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**COMBINED DECLARATION AND POWER OF ATTORNEY**

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL,  
DIVISIONAL, CONTINUATION OR CIP)

---

As a below named inventor, I hereby declare that:

**TYPE OF DECLARATION**

This declaration is of the following type: *(check one applicable item below)*

- ☒ original
- ☐ design
- ☐ supplemental

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application do not check next item; check appropriate one of last three items.

- ☐ national stage of PCT

NOTE: If one of the following 3 items apply then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP.

- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

**INVENTORSHIP IDENTIFICATION**

WARNING: If the inventors are each not the inventors of all the claims an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (*if only one name is listed below*) or an original, first and joint inventor (*if plural names are listed below*) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**TITLE OF INVENTION**

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FUEL COMPOSITION CONTAINING FRICTION MODIFIER

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## SPECIFICATION IDENTIFICATION

the specification of which: *(complete (a), (b) or (c))*

- (a) ☒ is attached hereto.
- (b) ☐ was filed on \_\_\_\_\_ as ☐ Serial No. \_\_\_\_\_ or ☐ Express Mail No.,  
as Serial No. not yet known \_\_\_\_\_ and was amended on \_\_\_\_\_ *(if  
applicable)*.

NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 C.F.R. 1.67.

- (c) ☐ was described and claimed in PCT International Application No. \_\_\_\_\_ filed on  
\_\_\_\_\_ and as amended under PCT Article 19 on \_\_\_\_\_ *(if any)*.

## ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application as defined in accordance with 37 C.F.R. §1.56.

## PRIORITY CLAIM (35 U.S.C. §119)(a)-(d)

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

*(complete (d) or (e))*

- (d) ☒ no such applications have been filed.
- (e) ☐ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

**PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION  
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. §119(a)-(d)**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
			<input type="checkbox"/> YES <input type="checkbox"/> NO
			<input type="checkbox"/> YES <input type="checkbox"/> NO

**CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)  
(35 U.S.C. §119(e))**

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below:

**PROVISIONAL APPLICATION NUMBER**

**FILING DATE**

\_\_\_\_/\_\_\_\_/\_\_\_\_

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**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS  
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

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**NOTE:** If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CIP APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. §120.

## POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (*List name and registration number*)

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## DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



## SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name as it should appear on the filing receipt and all other documents.

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### CHECK PROPER BOX(ES) FOR ANY OF THE FOLLOWING ADDED PAGE(S) WHICH FORM A PART OF THIS DECLARATION

- ☒ Signature for subsequent joint inventors.  
Number of pages added 1.
- ☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor.  
Number of pages added     .
- ☐ Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 C.F.R. §1.47.  
Number of pages added     .

\*\*\*

- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (CIP) application.  
Number of pages added     .

\*\*\*

- ☐ Authorization of attorney(s) to accept and follow instructions from representative.

\*\*\*

If no further pages form a part of this Declaration then end this Declaration with this page and check the following item.

- ☐ This declaration ends with this page.

**SIGNATURE FOR JOINT SUBSEQUENT INVENTORS**

Full name of **third joint inventor** Benjamin J. Kaufman

Inventor's signature 

Date 9/14/00 Country of Citizenship U.S.

Residence Hopewell Junction, New York

Post Office Address 35 Newhard Place, Hopewell Junction, New York 12533

Full name of **fourth joint inventor** Michael G. Rawdon

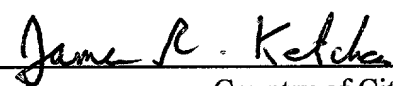
Inventor's signature 

Date Sep. 12, 2000 Country of Citizenship U.S.

Residence Poughkeepsie, New York

Post Office Address 28 Scofield Heights, Poughkeepsie, New York 12603

Full name of **fifth joint inventor** James R. Ketcham

Inventor's signature 

Date Sep 12, 2000 Country of Citizenship U.S.

Residence Salt Point, New York

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Full name of **sixth joint inventor** Bryce Alexander Wyman

Inventor's signature 

Date SEP 12, 2000 Country of Citizenship U.S.

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